

# **Idaho State Department of Agriculture Nursery and Florists Advisory Committee Final Project Report**

**Title:** Evaluation of Corkbark and Subalpine Fir for Their Potential as Ornamental Nursery Stock and Christmas Trees - 2003 - Grant No. NAC/ISDA 2003-1

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## **Introduction:**

This report covers the fourth year of what is planned as a ten-year study on the growth and development of subalpine and corkbark fir from selected seed sources in the southwestern United States. Seed sources represented in the collection are listed in Tables 1-3. Seeds were planted in styrofoam blocks in 1998 and transferred as plug-2 seedlings into a transplant bed in 2000. In the spring of 2001, the trees were transplanted into nursery plots at three sites in Bonner and Boundary County, Idaho. Trees were also distributed to Paradise Tree Farm in Enterprise, Oregon. Measurements at the Oregon site will be made only at the end of the trials.

## **Results and Discussion:**

Tables 1-3 summarize the results from each of the three north Idaho nursery sites. Results include tree height at the end of 2001, leader growth in 2002 and 2003, lamas growth in 2003, and survival at the end of 2003. In addition to leader and lamas growth, frost damage was measured at the three Idaho plantings in 2002 and 2003. Dates of bud break, shown in Table 4, were recorded at the University of Idaho Sandpoint Research & Extension Center (SREC) in 2002 and 2003.

Survival varied between sites and, in some cases, seed sources. Trees at the SREC were irrigated three or four times annually from 2001-2003, with an approximate total of eight inches of water applied annually during July and August. SREC-grown trees exhibited the greatest survival, averaging

96% for corkbark and 98% for subalpine fir as of September 2003. Most of the mortality at the SREC occurred during early spring of 2002 when many of the trees were frost heaved from the silt-loam soil and had to be replanted. Unirrigated trees at PossAbilities Tree Farm exhibited somewhat variable results, with survival ranging from a low of 47% for Santa Fe corkbark to 100% for two other corkbark sources. It appears probable that the Santa Fe corkbark seedlings suffered preplant damage prior to shipping to the PossAbilities site. Excluding the Santa Fe seedlings, corkbark fir survival at PossAbilities averaged 97%. Subalpine fir survival at the PossAbilities site was lower than for corkbark, ranging from 64% to 95% and averaging 82%. Survival was poorest at Birchhaven (unirrigated), with complete loss of trees from four corkbark and one subalpine seed source. Survival of the two remaining corkbark seed sources at Birchhaven averaged 39% and the nine remaining subalpine fir seed sources averaged 49% survival.

Frost damage to newly opened buds was widespread at all three Idaho sites during the spring of 2003. Frost damage was greatest at the SREC, where damage averaged 100% for both corkbark and subalpine fir. At the PossAbilities site, 100% of the corkbark trees exhibited frost damage, while damage to subalpine fir ranged from 71 to 100%, averaging 95% of the trees. The incidence of frost-damaged buds was lowest at the Birchhaven site where 84% of the corkbark and 93% of the subalpine fir exhibited frost-damaged buds. At the SREC, frost damage apparently occurred on May 6 when the nighttime temperature dropped to 27°F and/or on May 17-19 when nighttime temperatures of 29°F were recorded. Less frost damage at the Birchhaven and PossAbilities sites corresponded with seed sources exhibiting little growth. Lack of frost damage may well have been due to the absence of new buds, rather than to increased cold hardiness or avoidance of frost.

The average dates of bud break (needles from one or more buds on a tree being visible) were remarkably consistent among all of the seed sources and between subalpine and corkbark trees, as they were in 2002. Buds broke on all species approximately six to thirteen days earlier in 2003 than in 2002, due to warm spring weather. In 2003, the first dates of bud break ranged from April 21 through April 25 for subalpine seed sources. All subalpine trees had open buds by May 2. On average, subalpine trees exhibited open buds on April 25, with a range from first to last trees with open buds averaging 8 days. Results for corkbark fir were similar, with an average opening date of April 27 and an average range of opening dates of 9 days. Compared with concolor fir (*Abies concolor*, Rio Grande National Forest seed source) and Colorado spruce (*Picea pungens*, San Juan National Forest seed source) trees in nearby blocks, subalpine and corkbark trees broke bud earlier, as they did in 2002. Bud break on concolor trees occurred between about May 5 and May 21, averaging May 13. Colorado spruce buds opened between May 5 and May 16, averaging May 11. Little or no frost damage was observed on concolor fir or Colorado spruce. It should be noted that the concolor fir and spruce trees were planted in 1996 and approaching harvest size, as opposed to the small subalpine and corkbark fir seedlings. Frost damage was most prominent on the lower, southwestern sides of the trees where heat from the ground may have encouraged earlier bud break. By the first of July, the corkbark and subalpine fir seedlings at the SREC were exhibiting vigorous growth with earlier frost damage having little impact on the appearance of most trees.

Corkbark fir leaders developed about equally with irrigation (SREC) or without it (PossAbilities Tree Farm), with soil conditions and cultural practices being similar (Figures 1 and 3). Under unirrigated conditions, seedlings derived from the Apache National Forest exhibited significantly greater growth than did corkbark fir from other seed sources. Differences between seed sources for irrigated trees were less noticeable. Lamas growth from buds formed on leaders during 2003 appeared to be slightly greater on irrigated trees.

For all three sites, subalpine fir derived from the Kaibab National Forest exhibited the greatest leader elongation, with the Uncompahgre seed source also performing well. Differences for both corkbark and subalpine fir were more apparent between seed sources on unirrigated plots than irrigated plots.

**Conclusions:**

Corkbark and subalpine fir have been successfully established in both irrigated and unirrigated nursery plots on silt-loam soils in northern Idaho. Irrigation appears to provide an advantage for early survival, particularly for subalpine fir. Irrigated trees appeared to have more and fuller lateral branches than did unirrigated trees, creating denser and more attractive trees. Irrigated trees also appeared to produce more lateral growth following spring frosts than did unirrigated trees, possibly due to greater numbers of lateral buds. Differences in survival and growth on unirrigated plots may relate to weed control. Neither species emerged as a strong competitor with weeds. After one year in a transplant bed and three growing seasons in nursery plots, many trees began developing leaders eight to twenty inches in length. Susceptibility to spring frost continues to be problematic, particularly when compared with nursery staples, such as Colorado spruce, which breaks dormancy later and over a longer time. While corkbark and subalpine fir appear to offer commercial promise, both present frost risks, require careful site selection, and should not comprise the sole crop(s) at a nursery.

**Future Plans:**

Provided grant funding continues, survival, frost damage, and growth will be measured annually at the SREC, PossAbilities, and Birchhaven plots. Dates of bud break will be measured annually at the SREC and a heat unit model developed to assist in site selection and predict frost damage. During 2004, efforts will be made to determine whether irrigation increases lateral growth and produces fuller trees. As the trees approach harvest size, needle length, color, and retention after cutting for Christmas trees will be characterized, and the trees will be graded according to standards for Christmas trees and nursery stock. Survival and tree heights at Paradise tree farm will be measured at the time of harvest.

Table 1. Average height, growth, survival, and frost damage for five-year-old corkbark and subalpine fir seedlings at Birchhaven Nursery.

Seed source (National Forest)	Variety	2001 Height <sup>1</sup> (cm)	2002 Leader Growth <sup>2</sup> (cm)	2003 Leader Growth <sup>3</sup> (cm)	2003 Lamas Growth <sup>4</sup> (cm)	Survival <sup>5</sup> (%)	2003 Frost damage <sup>6</sup> (%)
Arapaho	Subalpine	13.9	2.4	3.5	0	64	88
Carson	Subalpine	15.8	3.0	3.8	0	9	100
Cibola	Subalpine	15.1	2.7	4.8	0.4	46	88
Dixie	Subalpine	20.7	5.0	11.6	0	90	100
Kaibab	Subalpine	22.5	4.7	11.4	3.9	65	97
Manti-LaSal	Subalpine	19.6	3.9	7.0	0	37	90
Rio Grande	Subalpine	11.3	...	...	...	0	...
San Isabel	Subalpine	16.4	4.7	4.0	0	69	100
San Juan	Subalpine	15.3	1.5	4.2	0	57	92
Uncompahgre	Subalpine	20.5	4.5	5.1	0	56	80
<b>Subalpine average</b>		<b>18.4</b>	<b>3.8</b>	<b>7.3</b>	<b>0.9</b>	<b>49.3</b>	<b>92.8</b>
Apache-Sitgreaves	Corkbark	Trees removed from planting due to poor survival					
Cibola	Corkbark	20.1	2.63	3.6	0	32	83
Cocino	Corkbark	Trees removed from planting due to poor survival					
Coronado	Corkbark	Trees removed from planting due to poor survival					
Gila	Corkbark	Trees removed from planting due to poor survival					
Santa Fe	Corkbark	21.0	2.9	3.9	0.1	45	85
<b>Corkbark average</b>		<b>20.9</b>	<b>2.8</b>	<b>3.9</b>	<b>0.1</b>	<b>38.5</b>	<b>84.0</b>

1. Height = average height from the ground to the topmost tip of the leader at the end of 2001  
2. 2002 leader = average length of leader formed during 2002  
3. 2003 leader = average length of leader formed during 2003  
4. 2003 lamas = average length of longest lamas shoots (maximum of one measured per tree) formed during 2003  
5. Survival = percentage of trees alive in September 2003  
6. Frost damage = percentage of trees exhibiting one or more frost-damaged buds in May 2003

Table 2. Average height, growth, survival, and frost damage for five-year-old corkbark and subalpine fir seedlings at PossAbilities Tree Farm.

Seed source (National Forest)	Variety	2001 Height <sup>1</sup> (cm)	2002 Leader Growth <sup>2</sup> (cm)	2003 Leader Growth <sup>3</sup> (cm)	2003 Lamas Growth <sup>4</sup> (cm)	Survival <sup>5</sup> (%)	Frost damage <sup>6</sup> (%)
Arapaho	Subalpine	11.1	1.7	1.5	0	74	71
Carson	Subalpine	14.8	4.1	7.5	0	64	100
Cibola	Subalpine	13.1	2.7	5.4	0.8	64	96
Dixie	Subalpine	15.2	3.2	4.1	0	79	100
Kaibab	Subalpine	17.3	4.3	9.8	1.7	90	100
Manti-LaSal	Subalpine	13.6	4.8	13.8	0	93	100
Rio Grande	Subalpine	11.8	3.1	2.3	0	83	100
San Isabel	Subalpine	Not planted at this site					
San Juan	Subalpine	13.0	3.4	2.8	0	95	100
Uncompahgre	Subalpine	18.5	3.9	7.0	0.4	92	100
<b>Subalpine average</b>		<b>14.4</b>	<b>3.5</b>	<b>6.3</b>	<b>0.4</b>	<b>81.6</b>	<b>94.6</b>
Apache-Sitgreaves	Corkbark	24.0	9.5	26.8	7.9	100	100
Cibola	Corkbark	21.6	8.4	14.6	3.9	95	100
Cocino	Corkbark	16.3	4.6	15.6	1.6	94	100
Coronado	Corkbark	20.7	6.7	15.3	3.5	100	110
Gila	Corkbark	25.0	5.6	13.9	4.2	94	100
Santa Fe	Corkbark	19.2	3.9	9.7	0.5	47	100
<b>Corkbark average</b>		<b>21.0</b>	<b>6.1</b>	<b>15.4</b>	<b>3.3</b>	<b>88.3</b>	<b>100</b>

1. Height = average height from the ground to the topmost tip of the leader at the end of 2001

2. 2002 leader = average length of leader formed during 2002

3. 2003 leader = average length of leader formed during 2003

4. 2003 lamas = average length of longest lamas shoots (maximum of one measured per tree) formed during 2003

5. Survival = percentage of trees alive in September 2003

6. Frost damage = percentage of trees exhibiting one or more frost-damaged buds in May 2003

Table 3. Average height, growth, survival, and frost damage for five-year-old corkbark and subalpine fir seedlings at the University of Idaho Sandpoint R&E Center.

Seed source (National Forest)	Variety	2001 Height <sup>1</sup> (cm)	2002 Leader Growth <sup>2</sup> (cm)	2003 Leader Growth <sup>3</sup> (cm)	2003 Lamas Growth <sup>4</sup> (cm)	Survival <sup>5</sup> (%)	Frost damage <sup>6</sup> (%)
Arapaho	Subalpine	17.1	3.5	8.4	0	97	100
Carson	Subalpine	18.8	4.0	10.2	0.0	100	100
Cibola	Subalpine	17.4	4.4	11.7	2.8	97	100
Dixie	Subalpine	20.2	4.7	11.4	0.2	98	100
Kaibab	Subalpine	24.4	5.1	13.8	1.9	93	100
Manti-LaSal	Subalpine	19.8	3.8	9.3	0.1	97	100
Rio Grande	Subalpine	17.7	4.0	9.6	0.2	100	100
San Isabel	Subalpine	15.8	4.1	10.3	0.8	100	100
San Juan	Subalpine	19.1	4.7	10.2	0.0	100	98
Uncompahgre	Subalpine	21.8	4.5	12.0	0.3	100	100
<b>Subalpine average</b>		<b>19.2</b>	<b>4.3</b>	<b>10.7</b>	<b>0.6</b>	<b>98</b>	<b>99.8</b>
Apache-Sitgreaves	Corkbark	29.4	4.9	16.6	5.5	98	100
Cibola	Corkbark	24.2	4.3	13.2	2.7	98	100
Cocino	Corkbark	22.2	4.4	13.0	1.9	97	100
Coronado	Corkbark	23.2	4.8	13.7	5.8	97	100
Gila	Corkbark	28.2	4.4	16.3	11.9	93	100
Santa Fe	Corkbark	23.1	4.4	14.4	0.8	95	100
<b>Corkbark average</b>		<b>25.0</b>	<b>4.5</b>	<b>14.5</b>	<b>4.7</b>	<b>96</b>	<b>100</b>

1. Height = average height from the ground to the topmost tip of the leader at the end of 2001

2. 2002 leader = average length of leader formed during 2002

3. 2003 leader = average length of leader formed during 2003

4. 2003 lamas = average length of longest lamas shoots (maximum of one measured per tree) formed during 2003

5. Survival = percentage of trees alive in September 2003

6. Frost damage = percentage of trees exhibiting one or more frost-damaged buds in May 2003

Table 4. 2002 and 2003 bud break data taken at the University of Idaho Sandpoint R&amp;E Center.

Seed source (National Forest)	Species / Subspecies	2002				2003			
		First	Last	Average date	Range (days)	First	Last	Average date	Range (days)
Arapaho	Subalpine	5 / 1	5 / 6	5 / 2	6	4 / 21	4 / 30	4 / 25	9
Carson	Subalpine	4 / 29	5 / 3	4 / 30	5	4 / 21	4 / 28	4 / 23	7
Cibola	Subalpine	4 / 29	5 / 3	5 / 1	5	4 / 21	4 / 30	4 / 25	9
Dixie	Subalpine	5 / 1	5 / 3	5 / 1	3	4 / 21	5 / 2	4 / 27	11
Kaibab	Subalpine	5 / 1	5 / 13	5 / 4	13	4 / 25	5 / 2	4 / 29	7
Manti-LaSal	Subalpine	4 / 29	5 / 3	5 / 1	5	4 / 21	4 / 28	4 / 25	7
Rio Grande	Subalpine	4 / 29	5 / 3	5 / 1	5	4 / 21	4 / 28	4 / 24	7
San Isabel	Subalpine	4 / 29	5 / 1	4 / 30	3	4 / 21	4 / 28	4 / 24	7
San Juan	Subalpine	5 / 1	5 / 3	5 / 1	3	4 / 21	4 / 28	4 / 23	7
Uncompahgre	Subalpine	5 / 1	5 / 6	5 / 2	6	4 / 21	4 / 30	4 / 27	9
<b>Subalpine average</b>		<b>4 / 30</b>	<b>5 / 4</b>	<b>5 / 1</b>	<b>5.4</b>	<b>4 / 21</b>	<b>4 / 29</b>	<b>4 / 25</b>	<b>8.0</b>
Apache-Sitgreaves	Corkbark	5 / 1	5 / 8	5 / 3	8	4 / 23	5 / 2	4 / 28	9
Cibola	Corkbark	5 / 1	5 / 8	5 / 2	8	4 / 23	5 / 5	4 / 28	12
Cocino	Corkbark	5 / 1	5 / 13	5 / 4	13	4 / 23	5 / 2	4 / 28	9
Coronado	Corkbark	5 / 1	5 / 6	5 / 2	6	4 / 21	4 / 28	4 / 25	7
Gila	Corkbark	5 / 1	5 / 3	5 / 1	3	4 / 23	4 / 30	4 / 28	7
Santa Fe	Corkbark	5 / 1	5 / 6	5 / 2	6	4 / 21	5 / 2	4 / 27	11
<b>Corkbark average</b>		<b>5 / 1</b>	<b>5 / 7</b>	<b>5 / 2</b>	<b>7.3</b>	<b>4 / 22</b>	<b>5 / 2</b>	<b>4 / 27</b>	<b>9.2</b>
San Juan	Blue Spruce	5 / 17	5 / 26	5 / 20	9	5 / 5	5 / 16	5 / 11	12
Rio Grande	Concolor	---	5 / 20	---	---	5 / 5	5 / 21	5 / 13	17

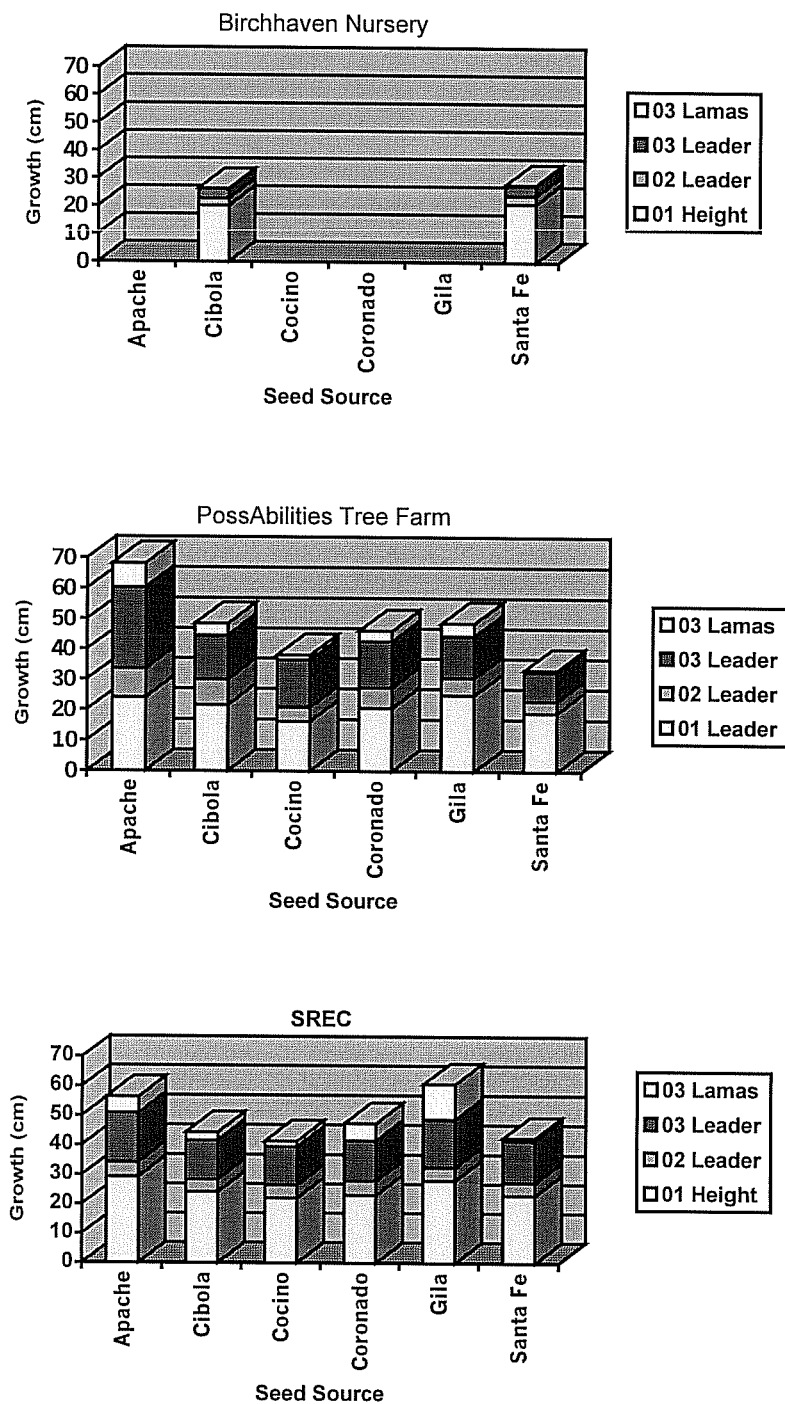


Figure 1. Growth of corkbark fir, sown in 1998, measured from 2001 through 2003 at three north Idaho sites: Birchhaven Nursery, PossAbilities Tree Farm, and Sandpoint Research & Extension Center. Missing columns indicate the corresponding seed source either died or was removed.



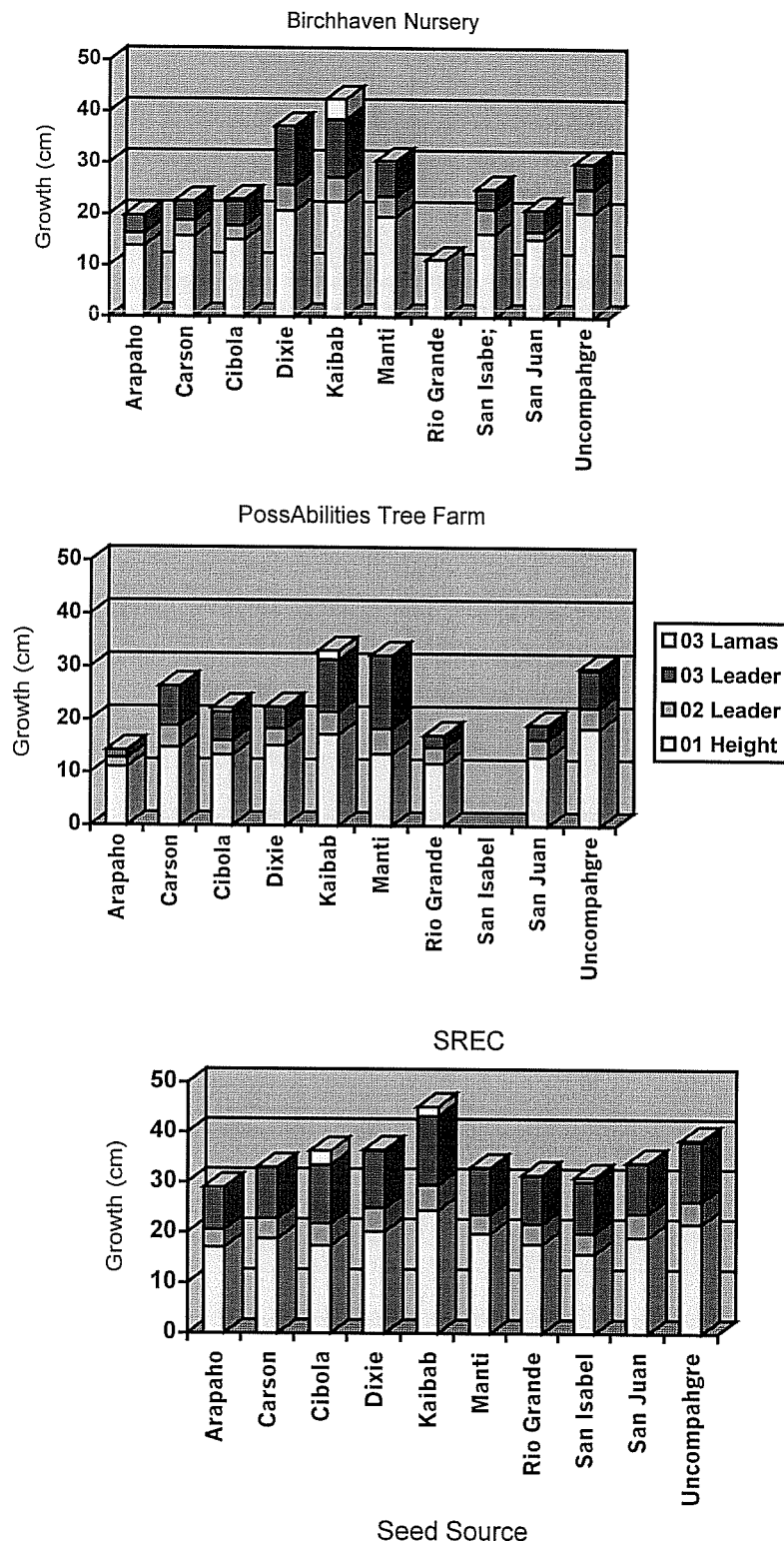


Figure 2. Growth of subalpine fir, sown in 1998, measured from 2001 through 2003 at three north Idaho sites: Birchhaven Nursery, PossAbilities Tree Farm, and Sandpoint Research & Extension Center. Missing columns indicate the corresponding seed source either died or was removed.

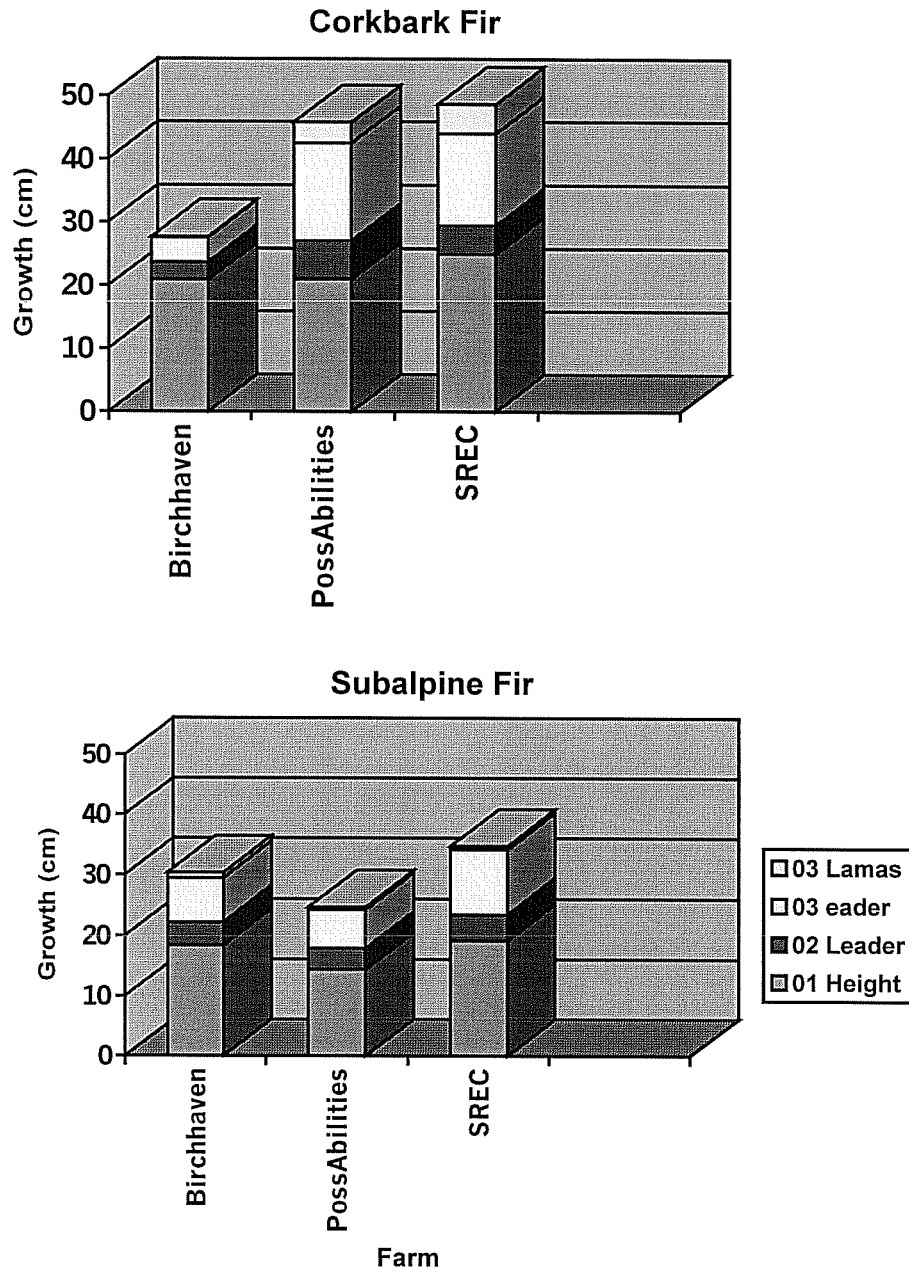


Figure 3. Total growth of A) corkbark and B) subalpine fir, sown in 1998, measured from 2001 through 2003 at three north Idaho sites: Birchhaven Nursery, PossAbilities Tree Farm, and the Sandpoint Research & Extension Center.